# Does playing futsal or football impacts players' physical, physiological, and tactical responses in a similar small-sided game? A study in different age groups

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## Abstract

This study compared young football and futsal players' physical, physiological, and spatial occupation responses from the U-15 and U-17 categories during 3vs.3 SSG. Twenty-four football and eighteen futsal regional-level players participated in the study. 3-a-side SSGs were played in both modalities, with rules and pitch size adapted to the rules of each one. GPS devices collected physical, physiological, and spatial occupation data. Data were compared using a two-way ANOVA. Football players presented higher physical and physiological responses than futsal players, while spatial occupation responses were similar between sports. Older players presented higher physical and physiological responses than younger ones, while the spatial occupation responses were similar between age categories. However, age-related differences in physical performance were only observed in football players. We conclude that the learning environment of each modality induces differences in performance over time, with tendencies of older athletes to present higher performance and football players to show more specific game-related responses.

Keywords: Futsal; Football; Youth sport; Tactical analysis; GPS devices.

## Introduction

Football and futsal are team sports usually taught simultaneously in youth academies in different countries. Based on the athletics skills model (ASM), it was advocated that futsal and football can be considered donor sports to each other. The practice of futsal could promote the specific transfer of skills for football, as the practice of football could promote the particular transfer of skills for futsal[1]. However, to really understand the contribution of each one to the other, there is a need to develop further research that characterizes specific skills or capacities that each one develops in youth players[2].

Futsal practice at young ages has been suggested to develop skills in football clubs due to the higher demand for decision-making within a shorter space and time[2,3]. Recent studies have shown that playing with high defensive pressures and using the futsal ball on hard surfaces enhanced learning and allowed passing skills transference for football contexts[4]. These results support practicing both sports in youth groups, although more studies are necessary to better understand this practice's impact on tactical and physical development.

Although both sports are used interchangeably in youth academies, differences between futsal and football regarding the number of players per team and the playing area in the formal game may stimulate the development of different capabilities in players who practice each sport. For example, a previous study showed that futsal athletes presented higher speed and strength performances for the lower limbs than football athletes, with no differences in agility performance[5]. Another study showed higher performance in repeated sprints for futsal than football athletes[6]. Although these studies suggest differences between football and futsal athletes, they were conducted only with adult players,

leading to a lack of information about younger players. Moreover, considering the use of both sports' small-sided games (SSG) during athletes' formation[7], it is essential to understand whether these differences in players' capabilities impact performance during SSG. Knowing players' behavior during SSG may help coaches plan training contents within each sport and, consequently, smooth players' transitions between sports.

Besides the importance of training, small-sided games have been proposed to be introduced as an evaluation tool for young athletes[8-10]. This inclusion is justified by the measures' high representativity and ecological validity compared to the traditional laboratory and analytical tests. Also, players' performance in football and futsal is characterized by a multidimensional nature, in which physical (e.g., the external load, measured by distances covered at different speed thresholds)[11,12], physiological (e.g., the internal load, measured by heart rate responses)[13,14], and tactical (e.g., the players' responses to emerging problems, measured by spatial occupation on the field)[15,16] play a significant role. In this sense, SSGs are advantageous as training and assessment tools as they allow a multidimensional players' analysis within the same session[17]. For this reason, analyzing futsal and football players' performance in game-based tasks – such as the SSGs – would provide an interesting point of view on the actual differences between the modalities, which was not fully addressed by the available literature. Specifically, the reported differences between the players from the two modalities refer to physical parameters[5,6]. From a pedagogical point of view, the lack of knowledge on the actual differences between players from the two modalities impairs the ability to adequately comprehend the transition from futsal to football (and vice versa) when both are offered by clubs and confederations in youth academies simultaneously.

Youth academies are highly heterogeneous for maturation and performance levels, as well as for time and the quality of practice. Indeed, age-related differences in tactical and physical performances in different SSGs were extensively pointed out in the literature[18-21]. Knowing age-related differences helps coaches adequately plan task constraints regarding players' current skills[15,18]. However, even if these differences were previously addressed, it remains unknown whether age-related differences might be sport-specific when comparing futsal and football players. Based on environmental differences between the modalities, which could raise different training demands over time, probably some age-related differences could be observed in the performance of futsal and football players.

Considering the abovementioned issues, although futsal and football practice have been adopted during athletes' formative stages, information on younger players and the differences in the impact of this practice on performance between age categories are scarce. This knowledge may allow coaches to identify players' capabilities better, improving the selection of players for each sport. Therefore, this study aimed to compare the physical, physiological, and spatial occupation performances of U-15 and U-17 futsal and football players during 3vs.3 small-sided games. We hypothesized that 1) football players would present higher physical and physiological performances and a higher spatial occupation than futsal players and 2) age-related differences are not similar in the modalities.

## Methods

### *Participants*

Forty-two athletes participated in this study. Twelve athletes were from the U-15 category (age: 13,0 ± 0,4 years; body mass: 53,5 ± 8,7 kg; percentage body fat: 17,9 ± 3,7; stature: 163 ± 8,5 cm) and twelve from the U-17 category (age: 15,6 ± 0,5 years; body mass: 66,0 ± 10,2 kg; percentage body fat: 15,7 ± 5,9; stature: 174,6 ± 6,7 cm) of a Portuguese regional-level

football club. Six athletes were from the U-15 (age: 13,2 ± 0,7 years; body mass: 56,1 ± 8,6 kg; percentage body fat: 18,5 ± 5,1; stature: 163,9 ± 10,4 cm) and twelve from the U-17 categories (age: 15,3 ± 0,7 years; body mass: 63,9 ± 10,0 kg; percentage body fat: 16,3 ± 4,0; stature: 174,2 ± 4,6 cm) of a Portuguese regional-level futsal club. All players had an average of three weekly training sessions and a match on the weekends. Athletes and their legal guardians were clarified about research procedures and voluntarily agreed to participate in the study by signing informed consent. The clubs' scientific committee approved the study of Sports Sciences and the Universidade da Beira Interior A42790-2019 ethics committee.

### *Procedures*

The independent variables were the age category (U-15 and U-17) and the sport modality (futsal and football). Data collection lasted two days at each club's facility after 6:00 p.m. (TABLE 1). On the first day of data collection, athletes' anthropometric characteristics were assessed at the beginning of the session. On both days, athletes wore a GPS unit and a heart rate monitor and performed an 8-minute standardized warm-up (lateral displacements, jumps, and sprints) before participating in the SSG.

TABLE 1 - Data collection schedule.

| Week | Weekday | Confronts | Category | Sport |
|---|---|---|---|---|
| 1 | Monday | AxB and CxD | U-15 | Football |
| | Tuesday | AxB | U-15 | Futsal |
| | Thursday | AxB and CxD | U-17 | Futsal |
| | Friday | AxB and CxD | U-17 | Football |
| 2 | Monday | AxB and CxD | U-15 | Football |
| | Thursday | AxB | U-15 | Futsal |
| | Thursday | AxB and CxD | U-17 | Futsal |
| | Friday | AxB and CxD | U-17 | Football |

According to players' positions, the coach divided athletes into 3-player balanced teams in the football group (1 defender, 1 forward, and 1 midfielder), similar to previous studies[15,20,22]. Playing positions were not used to balance teams in futsal categories due to this sport's higher variability in positional characteristics.

The small-sided game 3-a-side plus goalkeepers, played on a 36mx27m (162m² per player) grass field with two 6m x 2m goals, with all official football rules, was adopted to evaluate football players. This field dimension followed the same proportions established for the formal football game and has been previously adopted in the literature[23]. Futsal athletes also performed a 3vs.3 SSG with goalkeepers on a 37,5m x 16m (100m² per player) futsal court and 3m x 2m goals. The dimensions of the playing area followed the same proportions as the official futsal game. The same procedures were performed with the football players within each data collection session, except in the U-15 category, which had fewer participants, and only the AxB confrontation was carried out. Each team played three 4-minute SSG bouts with four minutes of passive rest in between (TABLE 1). Teams CxD started the warm-up four minutes after the AxB to avoid intervals between the end of the warm-up and the start of the SSG. A referee was positioned on the sideline of the pitch during the games to ensure the rules were followed by the players. Data recorded by the GPS and heart rate monitors were exported to a computer for further analysis

### *Instruments and Variables*

Physical, physiological, and spatial occupation variables were obtained using a heart rate monitor (Garmin Ltd., Olathe, Kansas, USA) and the WIMU PRO GPS equipment (Realtrack Systems, Almeria, Spain). External antennas were used to allow indoor data collection. This equipment is reliable

for measuring acceleration[24]. Physical variables comprised measuring players' acceleration actions and distances covered at different speed thresholds, as extensively adopted in the literature[25,26]. Physiological responses were measured through heart rate responses[27,28]. Finally, the spatial occupation, measured as the team's occupied area, was evaluated as a measure of collective tactical positioning on the pitch[29,30]. TABLE 2 shows the dependent and independent variables.

TABLE 2 - Dependent and independent variables.

| Variable | Type | Levels | Description |
|---|---|---|---|
| Category | Independent | U-15 | |
| | Independent | U-17 | |
| Sport | Independent | Football | |
| | Independent | Futsal | |
| Distance covered (m) | Dependent | DTotal (m) | Total distance covered |
| | Dependent | D0-7 km/h (m) | Distance covered at speeds 0-7 km/h. |
| | Dependent | D7-14 km/h (m) | Distance covered at speeds 7-14 km/h. |
| | Dependent | D14-21 km/h (m) | Distance covered at speeds 14-21 km/h. |
| | Dependent | D>21 km/h (m) | Distance covered at speeds above 21 km/h. |
| Accelerations (m/s²) | Dependent | Accel. 1-2,5 m/s² (n) | Number of accelerations performed at 1-2,5 m/s². |
| | Dependent | Accel. 2,5-4 m/s² (n) | Number of accelerations performed at 2,5-4 m/s². |
| | Dependent | Accel. >4 m/s² (n) | Number of accelerations performed above 4 m/s². |
| | Dependent | Accel. -2,5-(-1) m/s² (n) | Number of decelerations performed at -2,5-(-1) m/s². |
| | Dependent | Accel. -4-(-2,5) m/s² (n) | Number of decelerations performed at -4-(-2,5) m/s². |
| | Dependent | Accel. <-4 m/s² (n) | Number of decelerations performed below -4 m/s². |
| Heart rate (%) | Dependent | HR80-90% | Percentage of time spent at heart rates between 80 and 90% of maximum heart rate. |
| | Dependent | HR90-95% | Percentage of time spent at heart rates between 90 and 95% of maximum heart rate |
| | Dependent | HR>95% | Percentage of time spent at heart rates above 95% of maximum heart rate. |
| Team area (m²) | Dependent | Team area (m²) | The area formed by the distances between the three players of a team. |

D = distance;
Accel = accelerations;
HR = heart rate.

### *Data Analysis*

Data was first checked for normality (Shapiro-Wilk's) and homoscedasticity (Levene's). Due to the small sample size, bootstrapping resampling techniques were adopted, as recommended in the literature[31,32]. Data were analyzed using a two-way mixed (within-between) ANOVA (category - 2 levels; sport - 2 levels). η2p effect size was calculated for the ANOVA and classified as small ($0.02 \leq \eta 2p < 0.13$), medium ($0.13 < \eta 2p < 0.26$), or large ($\eta 2p > 0.26$)[33]. Statistical significance was set at 5%. Comparisons were performed using SPSS software (Version 19.0 for Windows, SPSS Inc., Chicago, IL, USA).

## Results

TABLE 3 shows players' physical and physiological responses during the SSG. There was an interaction between factors for the total distance covered ($p$<0.001), the distance covered at speeds 7-14 km/h ($p$=0.025), and the number of accelerations at 1-2.5 m/s² ($p$=0.007), the number of accelerations at 2.5-4 m/s² ($p$=0.002), the number of decelerations at -4(-1) m/s² ($p$=0.001). In those cases, the p-value for the interaction was reported. For the other variables, we reported the p-values of each factor. TABLE 3 summarizes the descriptive data.

There was an effect of sports modality on players' physical and physiological responses. The results indicated that football players covered higher distances ($p$ < 0.001, η2p = 0.150, medium effect), higher distances between 0-7km/h ($p$ = 0.041, η2p = 0.017, small effect), and between 7-14km/h ($p$ < 0.001, η2p = 0.090, small effect), than futsal players. Within each sport, differences were reported only in the group of football players in which older players exhibited greater total distance ($p$ <0.001; η2p = 0.044, small effect) and distance between 14-21km/h ($p$ < 0.001; η2p = 0.087, small effect) than younger ones. When comparing the sports modalities, differences were also reported in the accelerations, with football players displaying more acceleration actions between 1.0-2.5 m/s² ($p$ < 0.001, η2p = 0.227, medium effect), 2.5-4.0 m/s² (p < 0.001, η2p = 0.129, small effect), and above 4.0m/s² ($p$ < 0.001, η2p = 0.097, small effect), than futsal players. Football players also performed more deceleration actions in the -1.0 - -2.5 m/s² (p < 0.001, η2p = 0.113, small effect), -2.5 - -4.0 m/s² (p < 0.001, η2p = 0.181, medium effect), and below 4.0 m/s² thresholds than futsal players. Finally, there were no sports-related differences in the physiological measures. Also, there were no differences in the spatial occupation between sports modalities.

There was also an effect of age group on physical and physiological players' responses. Older players covered higher distances ($p$ = 0.002, η2p = 0.039, small effect) and higher distances between 7-14 km/h (p = 0.034, η2p = 0.018, small effect) than the young ones. Older players also displayed more accelerations between 2.5-4.0 m/s² (p < 0.001, η2p = 0.093, small effect), decelerations between -2.5 - -4.0 m/s² ($p$ < 0.001, η2p = 0.055, small effect), and decelerations below -4.0m/s² (p = 0.014, η2p = 0.024, small effect) than the youngest group. Older players also remained for a longer period in the lowest assessed heart rate zone ($p$ = 0.020, η2p = 0.022, small effect) and a shorter period in the highest HR zone (p = 0.023, η2p = 0.021, small effect) despite running longer distances and performing more accelerations and deceleration actions. There were no differences in the remaining variables. There were also no differences in the spatial occupation between age groups.

TABLE 3 - Descriptive data.

| Variable | Football | | Futsal | | p-value age category (effect) | p-value sports modality (effect) | p-value interaction (effect) |
|---|---|---|---|---|---|---|---|
| | U-15 | U-17 | U-15 | U-17 | | | |
| **Total distance (m)** | 402.43(47.10) | 438.65(37.55) | 384.50(35.39) | 383.50(43.24) | 0.002(0.039) | <0.001(0.150) | 0.001(0.044) |
| **Distance between 0-7 km/h (m)** | 178.78(17.47) | 178.63(16.78) | 171.78(15.64) | 176.95(13.91) | 0.259(0.005) | 0.041(0.017) | |
| **Distance between 7-14 km/h (m)** | 176.32(45.87) | 193.85(36.12) | 157.48(28.09) | 161.83(39.01) | 0.034(0.018) | <0.000(0.090) | |
| **Distance between 14-21 km/h (m)** | 41.50(24.46) | 60.60(23.32) | 52.73(30.72) | 41.51(21.86) | 0.208(0.006) | 0.209(0.006) | <0.001(0.087) |
| **Distance above 21 km/h (m)** | 2.54(4.41) | 3.05(4.84) | 2.98(5.88) | 3.20(6.14) | 0.202(0.007) | 0.633(0.001) | |
| **Accelerations between 1.0-2.5 m/s² (n)** | 34.47(6.52) | 31.18(4.54) | 25.61(3.75) | 27.68(5.96) | 0.400(0.003) | <0.001(0.227) | <0.001(0.052) |
| **Accelerations between 2.5-4.0 m/s² (n)** | 7.83(3.44) | 9.33(2.82) | 4.92(2.35) | 7.43(3.06) | <0.001(0.093) | <0.001(0.129) | |
| **Accelerations above 4.0 m/s² (n)** | 0.57(0.73) | 0.56(0.77) | 0.03(0.17) | 0.22(0.56) | 0.288(0.005) | <0.001(0.097) | |
| **Decelerations between -1.0 - -2.5 m/s²** | 31.10(7.00) | 30.17(5.91) | 25.39(3.90) | 27.40(4.83) | 0.474(0.002) | <0.001(0.113) | |
| **Accelerations between -2.5 - -4.0 m/s²** | 8.68(3.07) | 9.28(2.87) | 5.00(2.63) | 7.31(2.87) | <0.001(0.055) | <0.001(0.181) | |
| **Accelerations below -4.0 m/s² (n)** | 0.88(0.99) | 1.24(1.05) | 0.11(0.40) | 0.31(0.60) | 0.014(0.024) | <0.001(0.187) | |
| **Heart Rate between 80-90% HR (%)** | 8.47(16.69) | 13.27(14.81) | 11.33(10.27) | 16.74(20.14) | 0.020(0.022) | 0.148(0.008) | |
| **Heart Rate between 90-95% HR (%)** | 9.83(14.61) | 17.93(15.53) | 17.55(19.96) | 12.11(13.40) | 0.513(0.002) | 0.640(0.001) | |
| **Heart Rate above 95% HR (%)** | 75.27(29.03) | 62.82(28.98) | 60.86(29.34) | 54.66(35.39) | 0.023(0.021) | 0.006(0.030) | |
| **Area Ocuppation (m)** | 32.41(12.36) | 27.65(5.71) | 26.52(2.79) | 27.96(4.50) | 0.364(0.010) | 0.127(0.029) | |

## Discussion

This study compared the physical, physiological, and spatial occupation performances of U-15 and U-17 futsal and football players during 3vs.3 small-sided games. According to our expectations, specific training of each sport modality leads to specific adaptations in players' capabilities and behaviors. The results generally indicated a higher physical performance of older players (age category effect), and football players tended to perform better than futsal ones (sports modality effect). When interaction effects were observed, within-sports differences emerged only in the football-related group, indicating that this modality's training process induces more specific adaptations than the futsal one. Finally, the magnitude of the differences was higher in the sports modality factor than in the age-group factor, which denotes a substantial level of specificity in players' actions in the modalities.

Due to differences in the field area, the number of players involved, the ball, or even the surfaces of play between football and futsal, it was suggested that each sport could lead to different individual capabilities. In fact, the results of this study revealed that football players presented higher physical and physiological responses than futsal players. Football players play in higher spaces during training sessions and competitions than futsal players. Thus, it could explain this higher physical and physiological play capacity during small-sided games. Following this idea, in this study, the relative area of the SSG (football 36m x 27m, 162m² per player; futsal 37,5m x 16m, 100m² per player) was similar to the formal game. Therefore, football players had a larger relative area and, consequently, the possibility to reach higher speeds and accelerations[34]. The literature has extensively addressed that larger pitches lead to higher physical-related responses[35]. Therefore, differences in the sports modalities could be explained by the spatial constraints present in each modality. Also, previous studies showed that when the physical demands are higher - mainly those in high-intensity, such as sprints - a higher physiological response is expected[12,36]. Therefore, the higher running speeds reached by football players led to higher heart rates, which explains the current result. Pitch surface is another factor that could explain sports-related differences[37,38]. However, to our knowledge, no previous study compared the physical performance of players on futsal and football surfaces, which impairs the possibility of inferring a causal relationship. Future studies should adequately address this issue, as a transition from futsal to football is quite common in different countries.

Results showed similar physical and physiological responses between U-15 and U-17 futsal players, but differences between age categories for football athletes were found. Differences between age categories may be related to maturational status since maturity influences lower limb power, and speed performances are influenced by maturity[39]. Thus, more mature athletes present higher levels of strength[40] and, consequently, higher physical responses and lower percentages of maximum heart rate. On the other hand, maturity seemed to have a lower influence on the physical responses during the futsal SSG, as no age-related differences were observed. For this reason, environmental conditions must be considered when analyzing such results in addition to maturational explanations. Specifically, the long-term exposure to a larger training pitch, requiring longer sprints, and the achievement of higher speeds by football players might have allowed the appearance of age-based differences in those capacities inherent to the performance in each modality. Previously reported differences in strength, sprint, and velocity performance[41,42] support this rationale. Therefore, besides nature, nurture factors might be considered to explain differences between futsal and football players. Further research should consider the performance factors and analyze the maturational status and morphological characteristics of football and Futsal players to improve the explanation of such differences. Interestingly, a recent manuscript that analyzed the relative age effect of football and futsal players revealed a significant relative age effect for football players of all ages and in futsal only in younger groups (U7 and U9), reinforcing the observed results[43].

Regarding the conditions of play of football and futsal, the reduction of the relative playing area decreases the available space per player,

leading players to get closer and play more collectively[44]. In this study, the total area was different between SSG protocols in each sport modality (972m² and 600m² for football and futsal, respectively), but there was no significant difference in the distance covered by players from each modality. We believe the offside rule may explain this result. A previous study showed that excluding this rule increased the in-length space exploration[45]. Since futsal does not have this rule, the effective playing space may have been similar to the football pitch during the SSG performed in this study, while in football, the offside rule may have decreased players' displacements. Therefore, the 3vs.3 futsal SSG presented a similar area occupied by players in football SSG, suggesting, at a certain point, that collective tactical demands between futsal and football 3vs.3 SSG were similar.

Although previous studies have shown differences in collective and individual tactical behavior between young players of different ages[18,46], the present study did not find these differences in the SSG. The area occupied by a team is indirectly related to the offense-defense dynamics[29]; when a team attacks, it tends to increase the space occupied to generate unbalance in the defense; when a team defends, it tries to reduce available spaces to counterbalance. In addition, younger players tend to solve game problems more individually and, therefore, get close to each other instead of playing collectively[44]. Due to the longer time of deliberate practice of older players, we expected the U-17 athletes to occupy a larger team area compared with U-15. However, the results did not meet these expectations, contradicting previous research[44]. The team area does not differentiate between offense and defense phases; therefore, older players may have occupied a larger space in offense and a smaller space in defense, leading to an average space similar to that of younger players. Future studies should investigate space occupation within each game phase to understand better players' behavior in different age categories and sports modalities.

Following the ASM perspective, football and futsal could be considered donor sports of each other[2]. This study leads to the understanding that football promotes the accelerated development of the physical capacities of players in comparison with futsal. Contrary to previous studies, no difference was observed in the spatial occupation of football and futsal players. However, this result could be related to the tactical variable used to measure teams' tactical adaptations during the practice of each SSG. As a limitation of this study, we can consider that only a general team variable was used to measure tactical behavior instead of individual variables that measure the effectiveness of football and futsal players' tactical behavior. Also, the number of U-15 futsal participants could be considered a limitation, which was lower than in the other groups, reducing the generalization power of the present results. Furthermore, differences between players might be due to the different constraints in each task (e.g., pitch surface and area). Therefore, future studies manipulating these constraints are required to confirm the current results. Moreover, participants participated in regional-level competitions and may present different responses from higher competitive levels. Finally, we suggest future studies investigating other training aspects, such as technical and individual tactical responses, to broaden the understanding of young players' responses in SSG.

## Conclusion

We conclude that the 3vs.3 futsal SSG induces similar space occupation to the 3vs.3 football SSG but with lower physical and physiological demands. Moreover, older players present higher physical and physiological responses than younger players, with the influence of age being more prominent in football than in futsal. Future studies should analyze the adaptations generated by training on the performance of both sports modalities (futsal and football).

## Conflict of interest

The authors state that there is no conflict of interest.


## Resumo

Praticar futebol ou futsal impacta na resposta física, fisiológica e ocupação espacial no pequeno jogo 3 vs 3? Um estudo em diferentes categorias.

Este estudo objetivou comparar o desempenho físico, fisiológico e a ocupação espacial de jogadores sub-15 e sub-17 durante pequenos jogos 3vs3. Vinte e quatro atletas de futebol e dezoito atletas de futsal de nível regional foram selecionados para o estudo. Pequenos jogos 3vs.3 foram praticados em ambas as modalidades, com regras e tamanho do campo adaptados a partir do jogo formal. Dispositivos de GPS coletaram os dados físicos, fisiológicos e a ocupação espacial. Os dados foram comparados usando uma ANOVA two-way. Atletas de futebol apresentaram maior resposta física e fisiológica e a ocupação espacial foi similar entre as modalidades. Jogadores mais velhos apresentaram maior resposta física do que os mais jovens, sem diferenças na ocupação espacial. Contudo, diferenças relacionadas à idade foram observadas apenas nos atletas de futebol. Conclui-se que o contexto de cada modalidade induz a adaptações diferentes ao longo do processo de formação esportiva, com uma tendência de maiores respostas em atletas mais velhos e uma maior especialização entre os atletas de futebol.


Palavras-chave: Futsal; Futebol; Categorias de base; Análise tática; Dispositivos de GPS.

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